amph.
Anthrop.
Archaeol.

3 1761 05346281 8

PALÆOLITHIC MAN

IN

EASTERN AND CENTRAL NORTH AMERICA.

I. COMPARISON OF PALAEOLITHIC IMPLEMENTS. F. W. PUTNAM, p. 421.

II. THE ANTIQUITY OF MAN IN THE VALLEY OF THE DELAWARE. CHARLES C. ABBOTT, p. 424.

III. THE AGE OF THE OHIO GRAVEL-BEDS. G. FREDERICK WRIGHT, p. 427.

IV. THE RECESSION OF THE ICE-SHEET IN MINNESOTA IN ITS RELATION TO THE GRAVEL DEPOSITS OVERLYING THE QUARTZ IMPLEMENTS FOUND BY MISS BABBITT AT LITTLE FALLS, MINN. WARREN UPHAM, p. 436.

V. DISCUSSION AND CONCLUDING REMARKS BY THE PRESIDENT. HENRY W. HAYNES, EDWARD S. MORSE, F. W. PUTNAM, p. 447.

[Reprinted from the PROCEEDINGS OF THE BOSTON SOC. NAT. HIST., VOL. XXIII.]

PEABODY MUSEUM AMERICAN ARCHAEOLOGY AND ETHNOLOGY.
CAMBRIDGE, MASS.
MAY, 1888.

PALÆOLITHIC MAN

IN

EASTERN AND CENTRAL NORTH AMERICA.

I. Comparison of Palaeolithic Implements. F. W. Putnam, p. 421.

II. The Antiquity of Man in the valley of the Delaware. Charles C. Abbott, p. 424.

III. The Age of the Ohio Gravel-beds. G. Frederick Wright, p. 427.

IV. The Recession of the Ice-sheet in Minnesota in its relation to the Gravel Deposits overlying the Quartz Implements found by Miss Babbitt at Little Falls, Minn. Warren Upham, p. 436.

V. Discussion and Concluding remarks by the President. Henry W. Haynes, Edward S. Morse, F. W. Putnam, p. 447.

[Reprinted from the Proceedings of the Boston Soc. Nat. Hist., Vol. xxiii.]

PEABODY MUSEUM AMERICAN ARCHAEOLOGY AND ETHNOLOGY.
CAMBRIDGE, MASS.
May, 1888.

PRINTED AT THE SALEM PRESS,
Salem, Mass.

General Meeting, Dec. 21, 1887.

The President, Prof. F. W. Putnam, in the chair.

The President, as a text for the discussion and papers for the evening, showed a collection of palæolithic implements from America and Europe.

The following is an abstract of his comments:—

It falls to me to open the discussions which are to follow, by calling your attention to the character of the objects known as palæolithic implements, or the weapons and tools of early man, which have been found under similar geological conditions in many portions of the world. For this purpose I have selected from the collections in the Peabody Museum of Archæology at Cambridge, a comparative series of specimens from both sides of the Atlantic.

Of the specimens before you, those from France were received at the Museum in the famous Mortillet collection and are from the gravel of the valley of the Somme, at Abbeville, where palæolithic implements were first discovered by M. Boucher de Perthes between the years 1840 and 1847, and at St. Acheul, where Dr. Rigollot next found them in 1855.

The single English specimen, brought in for comparison with American forms, was given to the Museum by Mr. John Evans of London, the author of the most thorough and important work ever written upon stone implements. This rude implement he obtained from Milford Hill, between the Avon and the Bourne, where many palæolithic implements have been found in the gravel, and were first described by Dr. Blackmore in 1865.

A large part of the American specimens on the table are from the gravels at Trenton, New Jersey, in the Delaware valley, where, in 1875, Dr. Abbott made the discovery of palæolithic implements in America. This place is of the same importance to American archæology that Abbeville is to European.

The several quartz implements from Little Falls, Minnesota, were collected by Miss Babbitt, the discoverer of palæolithic implements in the Upper Mississippi valley in 1879.

The two specimens found in the gravels of the Little Miami valley in Ohio, by Dr. Metz, the discoverer of palæolithic implements in Ohio, in 1885, are also on the table.

Thus there is now spread before you a remarkable group of authentic specimens of these implements of early man.

As they are passed about for examination, I will call your attention to a few matters of particular interest in connection with the forms which they present and the rocks of which they are made. As you probably know, the large proportion of palæolithic implements from France and England are made of nodules of flint, and that is the material of those before us from those countries. You will notice that while slight, if any, signs of use can be traced, they have a remarkable gloss over their chipped portions, which is analogous to the patina upon old bronze, and is an unquestionable sign of great age. Implements of the same character, but made of chert, quartzite, or other stones, have been found in the gravel deposits of England, and, I believe, on the continent also, but they are extremely rare.

In this country the term "flints" is applied generally to chipped implements made of chert, jasper, chalcedony, obsidian, quartz and other stones, but it is remarkable that with four exceptions all the implements known from the Trenton gravels are made of argillite, and that those from Little Falls are, without exception, made of quartz. The exceptions from Trenton are two of quartz, one of quartzite and one made from a black-chert pebble.

The first specimen found in Ohio is made from a pebble of black chert and is not only identical with the New Jersey specimen as to mineral but nearly so as to size and shape, and character of the chipping. The other specimen from Ohio is made from a hard dark pebble which has not yet been identified.

We have thus to compare implements made of several distinct minerals, which would from natural causes splinter and flake in different ways. Yet here before you, made of these several different kinds of rocks, are implements identical in shape, often agreeing in size and in minute points of structure, from both sides of the Atlantic and from distant points in America. If there are any persons present who may doubt the artificial character of the specimens, I can only say open your eyes and be convinced.

The rudest implement in the lot is the dark pebble found by Dr. Metz, twenty-five feet from the surface, in the gravel at Loveland, in the Little Miami valley, in 1886. That pieces or chips had been struck from this stone we must all admit, but that they were struck off by the hand of man we might well question had we not such a series as this now before us; where, with this rude specimen from the gravels of Ohio, we can make a close comparison with this one, of a different stone, from Le Moustier, an unquestionable implement of the early cave-men of France. A comparison of the two with this implement of argillite from Trenton (figure 418 of Dr. Abbott's Primitive Industry) and with this one of flint from the gravels of Milford Hill in England, shows how, in each successively, a few more chips have been struck from the stone until in this last, as rude as it is, there is none of the original surface of the flint remaining; while in the first from Ohio, only a portion of the surface of the pebble has been chipped or broken away, somewhat as in the specimen from St. Acheul represented by Mr. Evans on his plate II, fig. 15.

The two specimens to which I shall next call your attention were evidently designed as rude cutting implements to be held in the hand. They are remarkable for their close agreement in size and form, and outline of their slightly abraded cutting edges, yet one is of argillite from Trenton, and the other is of quartz from Little Falls.

As remarkable instances of identity in form and material, and close agreement in size, of implements from distant places, are the two well chipped pebbles of black chert; one from the gravel of Ohio and the other from that of New Jersey. The latter is figured in Dr. Abbott's volume (Primitive Industry, fig. 423). These closely resemble the ovato-lanceolate implement of flint from St. Acheul, figured by Mr. Evans (plate II, fig. 12).

Of similar interest are the two small ovate implements of white quartz, one from Trenton and the other from Little Falls. These again have their representatives among the flint implements of Great Britain, both as to size and shape, as shown by Mr. Evans' figure 452. The shoe-shaped implements (similar to fig. 429 of Mr. Evans' volume), flat upon one surface, and high at one end and chipped to the "toe" or point and over the front of the "foot," are found in Trenton chipped out of pieces of argillite. The specimen from Trenton, and the one of flint placed with it from St. Acheul, are interesting for their close resemblance in size and shape and uniformity of chipping.

Of the irregular ovate implements, like those called by Dr. Abbott "turtle backs" (fig. 444 of Primitive Industry), there are before you a specimen of argillite from Trenton (the original of Dr. Abbott's figure), and one of the same size and shape, but of flint, from St. Acheul. These two specimens, although of different size, are interesting from the fact that while they each have heavy buts, the opposite end of each is chipped to a rounded cutting edge, and they are nearly identical in form. Of a similar form is the British implement represented by Mr. Evans in his figure 418.

I will close my comparison of these implements, although it could be carried much farther with the specimens in the Peabody Museum, by calling your attention to these two large pointed implements, one of flint from the gravel of the Somme valley at St. Acheul, and the other of argillite from the gravel of the Delaware valley at Trenton. This is a form of palæolithic implement which is common to the gravels of France and England and they are generally of large size, like those before you. In both these specimens the original surface of the stone is left untouched at the large end and forms a smooth rounded portion which is perfectly adapted to be grasped and held by the hand. From this thick end the stone is regularly chipped on all sides until a long slender point is produced.

In the several instances to which I have called your attention, you can but perceive that man in this early period of his existence had learned to fashion the best available material, be it flint, argillite, quartz, chert or other rocks, into implements and weapons suitable to his requirements. You will also have noticed, during this comparison of the forms of the implements, that his requirements were about the same on both sides of the Atlantic, when he was living under conditions of climate and environment which must have been very near alike on both continents, and when such animals as the mammoth and the mastodon, with others now extinct, were his contemporaries.

Was he of one race on the two continents? Has he left descendants or has he passed out of existence with the mammoth and the mastodon? These are questions we hope may be answered in the near future.

ON THE ANTIQUITY OF MAN IN THE VALLEY OF THE DELAWARE.

BY DR. CHARLES C. ABBOTT.

Dr. Abbott began his remarks on the evidences of the Antiquity of Man in the Valley of the Delaware, and of his own more recent discoveries, by reading an abstract of a communication read, November last, by W J McGee before the Anthropological Society of Washington. In this paper the author gives the results of his examination of the surface geology of the locality in question. He states that there are two deposits of gravel covering the present valley, which are very distinct in origin, age and general character. The older and more extensive one is composed of usually small quartzite pebbles, or of fine quartzite sand, the latter frequently colored a deep reddish-brown from the abundant presence of oxide of iron. This deposit has been designated by Dr. Cook as the "southern drift," and by Professor Lewis as the "yellow gravel." Mr. McGee has proposed the name of "Columbian gravel." Overlying this, for a limited area, so that it forms the bed of the stream and lines its banks for some distance, both above and below tide-water limits, is another deposit of gravel, wholly different from the preceding, or "Columbian," in that it consists of pebbles and large boulders, with some sand. This is now well known as the Trenton gravel, being called so from the fact that its greatest deposit is at the site of the city of that name. It is an accumulation derived by water and ice-action from the terminal moraine of the second or last glacial period—the result of the floods that occurred during the melting and recession of the ice-sheet. At this time the region was so far depressed as to permit the tide to reach northward quite to the terminal moraine, some sixty miles beyond the present tide limit. This later deposit, then, is the most recent distinctly traceable phenomenon of the last glacial epoch.

It is in this accumulation of redistributed morainic material that the rudely chipped implements are found; and Mr. McGee points out that the conditions of the country, bounding the submerged area, were in all respects favorable for man's occupancy at that time.

Since the last occasion upon which the discoveries of rude or palæolithic implements from the Trenton gravel were announced to this society (1883), the various exposed sections of the deposit have been carefully examined by Dr. Abbott and several specimens of much interest have been obtained; and with these were two fragments of human crania, found at different, and both at very significant depths. No further evidence, it would now seem, was required to prove the occurrence of man on the Atlantic seaboard of North America in strictly glacial times, and yet many objections are still urged against this view.

One of these is that the so-called "implements" are too rude and indefinite in design to have been available for all of even primitive man's few wants, and yet nothing more elaborate of a different pattern is referred to the same age and origin. May not, it is asked, these "broken stones" be natural objects? The character of the fractures clearly proves that they are not. It is inconceivable that, in every case, the detached portions of a naturally broken stone should bear such relations to each other, that an effective cutting edge or penetrating point should result.

As Mr. McGee has pointed out, there was a wide tract of habitable land adjoining the area now covered by the Trenton gravels; and certainly there is no inherent improbability in the suggestion that a proportion of the ruder forms of stone implements found upon the surface of the Columbia gravel may not be properly referrible to the palæolithic folk rather than to the Indians that succeeded them. It is clearly evident that the typical palæolithic implements were weapons used in hunting, and as such would be used about the river where the greater portion of the game would be. Hunting implements would be liable to be lost; while the simple domestic implements, mostly used by the women in the preparation of food and clothing, would seldom, if ever, be carried to the river. As at present, we find a large range of objects of Indian manufacture confined to spots that give not only by their presence, but by other evidence, proof that such localities were village sites; while arrowheads and spearpoints are distributed over the whole country. So we find the single weapon of the older people in the gravels that once formed the river's bed, and very sparingly elsewhere; while equally rude objects—ordinarily classed as Indian relics—are sometimes found under conditions which strongly suggest that they were used by another and an earlier people; in other words, are contemporaneous with the objects found buried in the gravel.

There is unquestionably much to be done before every objection, that may fairly be urged, is met and answered; but the results so far obtained all point in the one direction, that of the existence of man in the Delaware Valley, when the "Trenton gravels" were being deposited.

ON THE AGE OF THE OHIO GRAVEL-BEDS.

BY REV. G. FREDERICK WRIGHT.

In November, 1880, I visited Trenton, New Jersey, in company with Professor Boyd Dawkins, Professor Henry W. Haynes, and Professor H. Carvill Lewis. Under the guidance of Dr. Abbott we visited all the sections of the Trenton gravel that were then exposed in fresh railroad cuttings and in embankments which had been recently undermined. Though not finding any palæolithic implements myself, several were found by Professors Haynes and Dawkins in piles of gravel where my inexperienced eye had only retained impressions of glaciated pebbles. One of the palæoliths found at that time is exhibited this evening by Professor Haynes; and both he and Professor Dawkins were satisfied that some of the implements they found must have lain in undisturbed deposits of the gravel, though they were actually found in the talus which had recently accumulated at the foot of the various cuttings of the bank. I have subsequently revisited the locality two or three times so as to increase my familiarity with the situation and character of the gravel deposits.

Shortly before our visit to Trenton the true glacial character of the gravel in which Dr. Abbott had found the palæolithic implements had been pointed out by Professor Cook, of the New Jersey Geological Survey. (See his report for 1878, p. 22, and Clay Report, 1878, p. 17.) It was at this time, and with these facts before us, that Professor Lewis and myself laid the extensive plans for the exploration of the southern boundary of the glaciated region to which I have since given unremitting attention during the leisure afforded from my regular duties.[1]

---

[1] Detailed results of my own work may be found in the joint report of Professor Lewis and myself in 1884 upon the Terminal Moraine of Pennsylvania (constituting volume Z in the Reports of the Second Geological Survey) and in my report upon The Glacial Boundary in Ohio, Indiana, and Kentucky (made to the Western Reserve Historical Society, Cleveland, Ohio, in 1884). My report upon the glacial boundary in Illinois, and of subsequent investigations in the Ohio valley, has not yet appeared, but will be published soon in a monograph on the whole subject prepared for the United States Geological Survey. Some additional facts may also be found in my chapter on the Glacial Boundary in Ohio, in volume V, of the Ohio Geological Survey, pp. 750–772, and in articles in the American Journal of Science, vol. XXVI (July, 1882), in the American Naturalist for August, 1884, in the Bibliotheca Sacra for April, 1884, and in the Ohio Archæological and Historical Quarterly for September and December, 1887; also in the report of the Meeting of this Society for Jan. 19, 1881 (vol. XXI, pp. 137–145); while a general discussion of the whole situation may be found in Chapter VI, of my volume entitled "Studies in Science and Religion."

The accompanying cut (Fig. 1) shows the relation of the palæolithic-bearing gravel at Trenton to the glacial period. The ice surmounted the Catskills, and extended down the valley of the

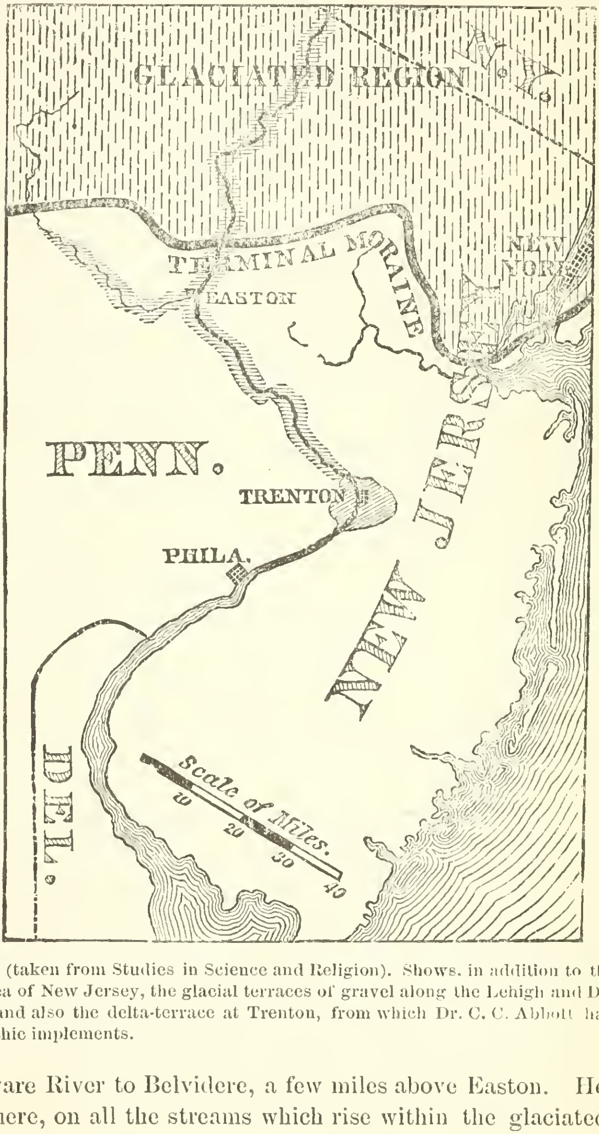


FIG. 1 (taken from Studies in Science and Religion). Shows, in addition to the glaciated area of New Jersey, the glacial terraces of gravel along the Lehigh and Delaware rivers, and also the delta-terrace at Trenton, from which Dr. C. C. Abbott has taken palæolithic implements.

Delaware River to Belvidere, a few miles above Easton. Here, as elsewhere, on all the streams which rise within the glaciated area and flow southward, extensive terraces of what are now called overwash gravels line the valley on either side down to tidewater, which is reached at Trenton. These terraces in the upper part of the valley are from twenty to forty feet above the present high-water mark. The valley descends through the most of its

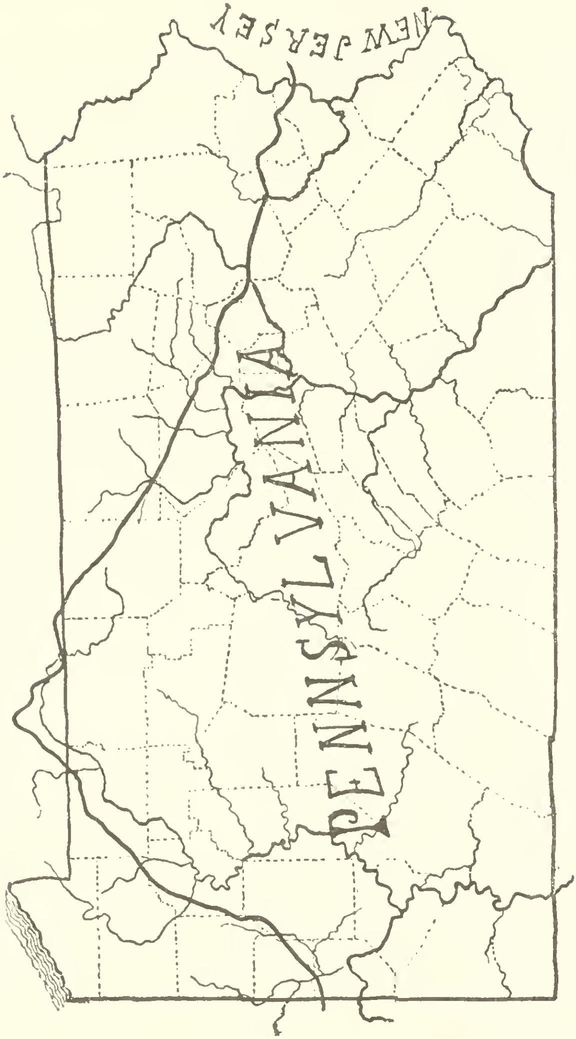


FIG. 2. The broad black line shows the southern boundary of the glaciated area of Pennsylvania and its relation to the drainage systems of the region.

course at the rate of two or three feet a mile, and is narrow. But at Trenton it suddenly enlarges, and comes down to the level of the tide. Here a wide and extensive delta-terrace is deposited, being about three miles in diameter. The surface of this delta-deposit is about fifty feet above tide and has a clearly defined margin all around, being composed of material derived from the valley above, and such as characterizes the glacial terraces lining the valley up to and beyond the terminal moraine; in short, it is a deposit of the overwash gravels laid down during the periodical floods incident to the presence of glacial ice in the upper portions of the drainage basin of the river.

Since my first visit to Trenton I have studied attentively all the streams situated like the Delaware with reference to the glaciated area between the Atlantic Ocean and the Mississippi River, and can state from personal observation, as partially recorded in the publications referred to, that a common cause, which cannot be anything else than glacial floods operating while the ice remained over the headwaters of these streams, has been at work making gravel deposits similar to those described along the Delaware. The accompanying cuts (see Figs. 2 and 3) show the relation of the various streams in Pennsylvania and Ohio to the continental ice-sheet while its front continued on the southern watershed of the continent. Without exception, those southerly flowing streams, whose drainage area lies to any considerable extent within the glaciated regions, are lined by extensive terraces of the overwash gravel of the glacial period.

On obtaining definite information as to these facts, I at once pointed out in my article in the American Journal of Science, vol. xxvi, pp. 7–14, as well as in my report to the Western Reserve Historical Society, pp. 26–27, and in the Ohio Archæological and Historical Quarterly, vol. i, pp. 176–177, the importance of having local observers turn their attention to the discovery of palæoliths at various points in Ohio, where the glacial conditions were similar to those in the valley of the Delaware at Trenton, N. J. The language in my report to the Western Historical Society (p. 26) is as follows: "The gravel in which they [Dr. Abbott's implements] are found is glacial gravel deposited upon the banks of the Delaware when, during the last stages of the glacial period, the river was swollen with vast floods of water from the melting ice. Man was on this continent at that period when the climate and ice of Green-land extended to the mouth of New York harbor. The probability is that if he was in New Jersey at that time he was also upon the banks of the Ohio, and the extensive terrace and gravel deposits in the southern part of our state should be closely scanned by archæologists. When observers become familiar with the rude form of these palæolithic implements they will doubtless find them in abundance. But whether we find them or not in this state [Ohio], if you admit, as I am compelled to do, the genuineness of those found by Dr. Abbott, our investigations into the glacial phenomena of Ohio must have an important archæological significance, for they bear upon the question of the chronology of the glacial period, and so upon that of man's appearance in New Jersey."

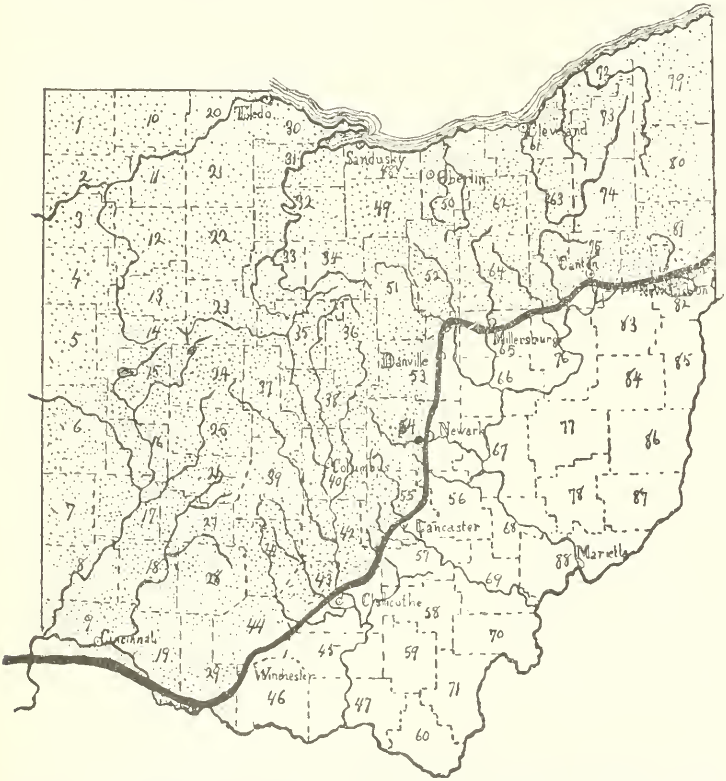


FIG. 3. The dotted surface shows the Glaciated area of Ohio. Hamilton county, bounded on the east by the Little Miami River, where Dr. Metz has found palæolithic implements, is indicated by the figure, 9.

The substance of these remarks had been previously made by me in a meeting of this Society for March 7, 1883, and reported in Science, vol. I, pp. 269–271. Commenting upon this report, Dr. Abbott sent a communication to *Science* from which the following extracts are very significant and interesting as connected with our discussion this evening (see Science, vol. I, p. 359) :—

"In *Science* of April 13, p. 271, Professor Wright remarks that 'no palæolithic implements have as yet been found [in Ohio], but they may be confidently looked for.' It has seemed to me possible, from my own studies of the remains of palæolithic man in the valley of the Delaware River, that traces of his presence may only be found in those river-valleys which lead directly to the Atlantic coast, and that palæolithic man was essentially a coast-ranger, and not a dweller in the interior of the continent. If we associate these early people with the seal and walrus rather than with the reindeer, and consider them essentially hunters of these amphibious mammals rather than of the latter, it is not incredible, I submit, that they did not wander so far inland as Ohio, nor even so far as the eastern slope of the Alleghanies; and we need not be surprised if palæolithic implements, concerning which there can be no doubt whatever,—for recent Indians made and used stone implements that are 'palæolithic' in character,—are not found in Ohio, nor even in Pennsylvania west of the valley of the Susquehanna River."

"On the other hand, if the relationship of palæolithic man and the Eskimo is not problematical, and the latter is of American origin, then I submit that man was preglacial in America, was driven southward by the extension of the ice-sheet, and probably voluntarily retreated with it to more northern regions; and, if so, then in Ohio true palæolithic implements will surely be found, and evidences of man's preglacial age will ultimately be found in the once glaciated areas of our continent."

The expectation of finding evidence of preglacial man in Ohio has at length been met.

At the meeting of this Society[1] for November 4, 1885, "Mr. Putnam showed an implement chipped from a pebble of black flint, found by Dr. C. L. Metz in gravel, eight feet below the surface, in Madisonville, Ohio. This rude implement is about the same size and shape of one made of the same material, found by Dr. Abbott in the Trenton, N. J., gravel, and is of special interest as the first one known from the gravels of Ohio." Professor Putnam's announcement, followed by a letter from Dr. Metz, saying that he had since found another implement in the gravel at Loveland, led me, on the 11th and 12th of November, to visit the localities and see their relation to the glacial deposits of the region. The results I here detail.

---

[1] See Proc. Bost. Soc. Nat. Hist., vol. XXIII, p. 242.

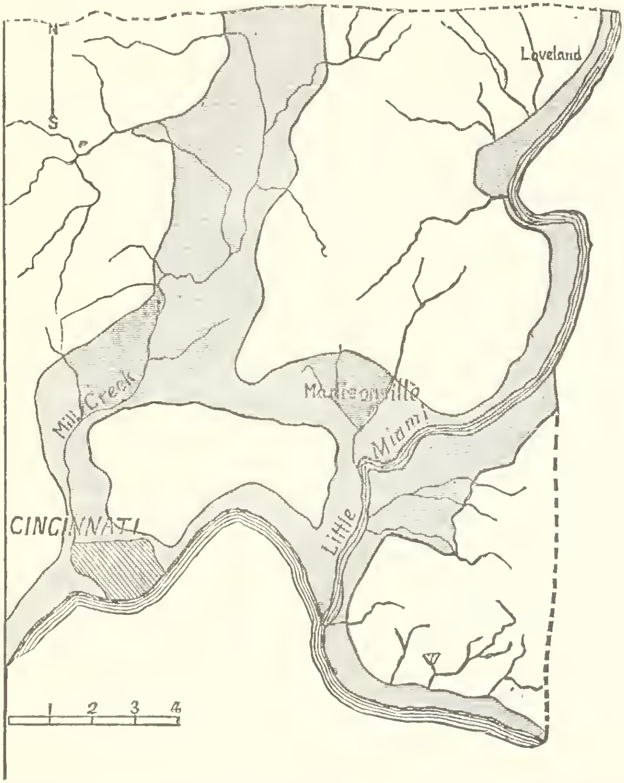


FIG. 4. Map of the eastern portion of Hamilton county, Ohio. The space covered by horizontal lines is occupied by preglacial valleys, filled to a height of 100 to 200 feet above the Ohio River with modified drift. The unlined portion consists of the table-land from 200 to 500 feet above the river.

Madisonville is situated eleven miles northeast of Cincinnati, in a singular depression connecting the Little Miami River with Mill Creek, about five miles back from the Ohio (see Fig. 4). The Little

Miami joins the Ohio some miles above Cincinnati, while Mill Creek joins it just below the city. The general height of the hills in that vicinity above the river is from 400 to 500 feet. But the hills just north of Cincinnati are separated from the general elevation farther back by the depression referred to, in which Madisonville is situated.

The depression is from one to two miles wide, and about five miles long, from one stream to the other, and is occupied by a deposit of gravel, sand and loam, clearly enough belonging to the glacial-terrace epoch. The surface of this is generally level, and is about 200 feet above the low-water mark in the Ohio. On the east side, on the Little Miami River, at Red Bank, the gravel is rather coarse, ranging from one to three or four inches, interstratified with sand, and underlain, near the river-level, with fine clay. There is here a thin covering of loess, or fine loam. On going westward this loess deposit increases in thickness, being at Madisonville, one mile west, about eight feet thick. Farther west it is much deeper, and seems to take the place of the gravel entirely. At several railroad cuttings, the compact glacial clay, technically called "till," with scratched stones, appears underneath all.

From this description it appears that this cross-valley, connecting Mill Creek with the Little Miami back of Avondale, Walnut Hills and the observatory, was once much deeper than now, and has been filled in with deposits made when immense glacial floods were pouring down these two streams from the north. The Little Miami was a very important line of glacial drainage, as is shown by the extensive gravel terraces all along its course, to which the railroads resort for ballast. The coarser material was deposited near the direct line of drainage, where the current was strong, while back from the river towards Madisonville, there is an increase of the fine deposit, or loess, which is practically a still-water formation.

In making an excavation for a cistern, Dr. Metz penetrated the loess just described eight feet before reaching the gravel, and there, just below the surface of the gravel, the implement referred to was found. There is no chance for it to have been covered by any slide, for the plain is extensive and level topped, and there had evidently been no previous disturbance of the gravel.

Subsequently, in the spring of the present year (1887), Dr. Metz found another palæolith in an excavation in a similar deposit in the northeast corner of the county, on the Little Miami across from Loveland. The river makes something of an elbow here, open to the west. This space is occupied by a gravel terrace about fifty feet above the stream. The terrace is composed in places of very coarse material, resembling very much that of Trenton, N. J., where Dr. Abbott has found implements. The excavation is about one-quarter of a mile back from the river, near the residence of Judge Johnson. The section shows much coarser material near the surface than at the bottom. The material is largely of the limestones of the region, with perhaps ten per cent of granitic pebbles. The limestone pebbles are partially rounded, but are largely oblong. Some of them are from one to three feet in length. These abound for the upper twenty feet of the section on the east side toward the river. One granitic boulder was about two feet in diameter. On the west side of the cut, away from the river, mastodon bones were found, a year or two ago, in a deposit of sand underlying the coarser gravel and pebbles. It was here, about thirty feet below the surface, that Dr. Metz found the palæolithic implement referred to.

In the light of the exposition just given, these implements will at once be recognized as among the most important archæological discoveries yet made in America, ranking on a par with those of Dr. Abbott, at Trenton, N. J. They show that in Ohio, as well as on the Atlantic coast, man was an inhabitant before the close of the glacial period. We can henceforth speak with confidence of interglacial man in Ohio. It is facts like these which give archæological significance to the present fruitful inquiries concerning the date of the glacial epoch in North America. When the age of the mound builders of Ohio is reckoned by centuries, that of the glacial man who chipped these palæolithic implements must be reckoned by thousands of years.

A word may properly be said with reference to the bearing of these facts upon the date of man's appearance in America. In the first place, it should be observed that, to say man was here before the close of the glacial period only fixes a minimum point as to his antiquity. How long he may have been here previous to that time must be determined by other considerations. Secondly, with our present knowledge of glacial phenomena, the date of the close of the glacial period is regarded as much more modern than it was a few years ago. Sir Charles Lyell's estimate of 35,000 years as the age of the Niagara gorge, which is one of the best measures of post-glacial time which has yet been studied, is greatly reduced by what we now know of the rate at which erosion is proceeding at the falls. Ten thousand years is now regarded as a liberal allowance for the age of that gorge. But, finally, the term "close of the glacial period" is itself a very indefinite expression. The glacial period was a long time in closing. The erosion of the Niagara gorge began at a time long subsequent to the deposit of the gravel at Trenton and at Madisonville. Between those two events time enough must have elapsed for the ice-front to have receded a hundred miles or more, or all the distance from New York to Albany; since only at that stage of retreat would the valley of the Mohawk have been freed from ice so as to allow the Niagara River to begin its work. The deposits at Trenton and Madisonville took place while the ice-sheet still lingered in the southern watershed of New York, Pennsylvania and Ohio.

THE RECESSION OF THE ICE-SHEET IN MINNESOTA IN ITS RELATION TO THE GRAVEL DEPOSITS OVERLYING THE QUARTZ IMPLEMENTS FOUND BY MISS BABBITT AT LITTLE FALLS, MINN.

BY WARREN UPHAM.

How far back in geologic time can the existence of man be traced? Answers to this inquiry come from various parts of Europe and North America, bearing testimony of man's great antiquity as measured by years, though recent in contrast with the long record of geology. The observations on this subject gathered in Great Britain, France, Germany and other countries of Europe, extend the human period with certainty back to the time when confluent ice-sheets covered Ireland, Scotland, and the northern borders of England, the whole of Scandinavia, northern Germany and northwestern Russia. Within this Ice Age, the latest in the series of geologic ages preceding the present, are found evidences of man's appearance in Europe. His rudely chipped stone implements occur there in caverns and in beds of fluvial gravel and sand high above the present river-courses, associated with bones of the reindeer and other Arctic animals, which the ice-fields had driven far southward of their present geographic limits. Both in Europe and America the great Ice Age appears to have comprised two principal glacial epochs when severe cold and plentiful snowfall caused vast ice-sheets to be accumulated upon the land, separated by a warmer interglacial epoch when the ice retreated, or was perhaps wholly melted away. These early vestiges of man in Europe are therefore referable to the interglacial epoch and to the second time of glaciation.

In the United States similar stone implements of early man are found near Trenton in New Jersey, in southern Ohio, and in central Minnesota, occurring in beds of gravel and sand, which are evidently modified drift derived from the receding ice-sheet of the last epoch of glaciation and deposited by the rivers that were produced in its final melting. During the last great rise of the quaternary lake Lahontan, in western Nevada, referable to the same late part of the glacial period, man hunted on its shores and was provided with spearheads of chipped obsidian[1]. Relics of man are also described from various placer gravels of California,[2] showing at least that he existed there contemporaneously with the foregoing, and probably even in a much earlier portion of the glacial period, near its beginning.[3]

The purpose of this paper is to describe the geologic situation and relationship of the gravel and sand deposits at Little Falls, Minnesota, in which Miss Franc E. Babbitt, several years ago, found implements and fragments of chipped quartz. After noting the character of the stratum where these remains of man's work occur, and of the underlying and overlying beds, their probable method of deposition will be indicated, and their place in the sequence of events constituting the history of the Ice Age will be shown. The recession of the ice-sheet of the last glacial epoch in Minnesota, to which this will direct our attention, seems to be clearly marked by as many as ten stages of halt or re-advance, in which distinct marginal moraines were accumulated, besides the moraine on the limits of its farthest extent. Six summers of geologic field-work in that state have been spent by the writer chiefly in the examination of its glacial and modified drift, of these moraines, and of the beaches and deltas of the glacial lake Agassiz, which was formed in the valley of the Red river of the north and of lake Winnipeg by the barrier of the departing ice-sheet. In their bearings upon this subject, my observation and study of that region convince me that the rude implements and fragments of quartz discovered at Little Falls were overspread by the glacial flood-plain of the Mississippi river, while most of the northern half of Minnesota was still covered by the ice, contemporaneously with its formation of the massive moraines of the Leaf hills and with the expansion of lake Agassiz on their west side, respectively 60 and 85 miles west of Little Falls. This was during the highest stage of lake Agassiz, and previous to its extension beyond the north line of Minnesota and Dakota. More than twenty lower beaches of this glacial lake have been traced, belonging to later stages in the recession of the ice-sheet, before it was melted so far as to reduce lake Agassiz to its present representative, lake Winnipeg. Estimated by comparison with the series of moraines and beaches formed during the glacial recession, the date of the gravel plain at Little Falls appears to be about midway between the time of maximum extent of the last ice-sheet and the time of its melting on the district across which the Nelson river flows to Hudson bay.

---

[1] See figure of implement in Monograph XI, U. S. Geol. Survey, p. 247. Pages 261, 263 and 269–270 of this volume show that this spearhead was lost in the lake sediments, during the second epoch of glaciation, to which also the implements in New Jersey, Ohio and Minnesota, are referable.

[2] The many occurrences of man's implements, stone mortars, etc., in the placers of California, as stated in Professor Whitney's report on the Auriferous Gravels, substantiate the history of the famous Calaveras skull, which is also there discussed. The great amount of erosion in California since the lava-flows indicates a very early time for that gravel of the old river-beds covered by lava.

[3] Professor Le Conte says, "These Drift-gravels probably represent the beginning of the Glacial epoch, though Whitney thinks an earlier or Pliocene epoch." *Elements of Geology*, revised edition, p. 555.

The town of Little Falls is on the east bank of the Mississippi river, in Morrison county, near the geographic centre of Minnesota. It is about a hundred miles northwest from Saint Paul and Minneapolis, and nearly an equal distance southeast from Itasca lake. The elevation of Itasca lake is about 1450 feet above the sea; of the Mississippi, at the head of the rapids, or Little Falls, from which the town derives its name, 1090 feet; and at the head of Saint Anthony's Falls in Minneapolis, 796 feet. Following the general course of the river, without regarding its minor bends, its descent from lake Itasca by Little Falls to Minneapolis averages about two feet per mile, and is approximately uniform along the entire distance. Considered in a broad view, this central part of the state may be described as a low plateau, elevated a few hundred feet above lake Superior on the east and the Red river valley on the west. In most portions it is only slightly undulating or rolling, but these smooth tracts alternate with belts of knolly and hilly drift, the recessional moraines of the ice-sheet, which commonly rise 50 to 100 feet, and in the Leaf Hills 100 to 350 feet, above the adjoining country. The bed-rocks are nearly everywhere concealed by the drift-deposits, into which the streams have not eroded deep valleys, their work of this kind being mostly limited to the removal of part of their glacial flood-plains. The upper portions of the Mississippi and of its chief tributaries, and all the smaller streams throughout this region, flow in many places through lakes which they have not yet filled with silt nor drained by cutting down their outlets. At Little Falls the glacial flood-plain of the Mississippi is about three miles wide, reaching two miles east, and one mile west from the river. Its elevation is 25 to 30 feet above the river at the head of the rapids, which have a descent of seven feet. The Mississippi here flows over an outcrop of Huronian slate, and the same formation is also exposed by the Little Elk river near its mouth, on the west side of the Mississippi three miles north of Little Falls. Veins of white quartz occur in the slate at both these localities, and were doubtless the source of that used by man here in the glacial period for the manufacture of his quartz implements.

The locality and section of the modified drift, where these worked fragments of quartz were found by Miss Babbitt, and the account of their discovery, are best told in her own words from her paper read before the anthropological section of the American Association for the Advancement of Science at its Minneapolis meeting in 1883. I quote as follows:

> "Rudely worked quartzes had previously been discovered here by the state geologist of Minnesota, Prof. N. H. Winchell, by whom they had been described and figured in the state geological report for 1877. . . . . The find reported by Prof. Winchell consists of chipped objects of a class generally ascribed to what is called the rude stone age. Of these many appear to be mere refuse, while others are regarded as finished and unfinished implements. The Winchell specimens have been assigned, upon geological ground, to a prehistoric era antedating that of the mound-building races, and reaching back to a time when the drift material of the terrace-plain was just receiving its final superficial deposit. It is

found that, at intervals, the surface soil of the terrace contains these quartzes to a depth of, not unfrequently, three or four feet.

"The lowest and newest formation at this place is the present flood-plain of the river. It is still in process of deposition, being yet subject to partial overflows at periods of exceptionally high water. In that portion of the town of Little Falls situated east of the Mississippi, this bottom-land is limited on the east by a high ancient river-terrace, which has here an average elevation of about 25 feet above the river. . . . . . This older terrace, like the present flood-plain, has been spread out by the immediate action of water. . . . . While occupied in examining the river bank at Little Falls in quest of wrought quartzes, one day during the season of 1879, I had occasion to ascend a slope lying between the new flood-plain and the older terrace, by a path leading through a sort of gap or notch in the latter (310 rods, very nearly, or almost one mile north of the east-west road by Vasaly's hotel; 10 rods west of the road to Belle Prairie; and 38 rods from the river). . . . . It seemed that at some past period a cut had been effected here by drainage, and that the washout thus formed had afterward been deepened by being used now and then as a wagon track. In this notch I discovered the soil to be thickly strewn with pieces of sharp, opaque quartz. These were commonly of a white color, and ranged in size from minute fragments to bits as large as a man's hand, and in some instances even larger. There were many hundreds of these chips visible, scattered over an area the width of the wagon road, and ten or fifteen yards in length. They were conspicuously unwaterworn, and likewise mostly unweathered, though occasionally a bit was picked up having some one of its surfaces weathered, while fractured or wrought faces, appearing upon other parts of it, looked as fresh as if the work of yesterday. On the other hand, the mass of stone rubbish upon and among which the quartzes were strewn is much waterworn, many of the pieces being well rounded, while none of them are wholly angular.

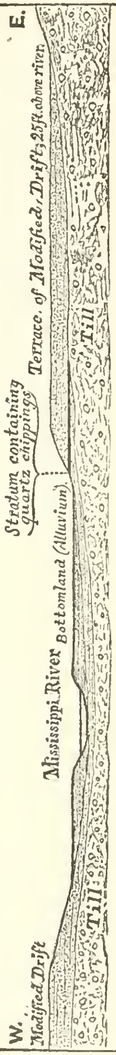
"By continued observations at this locality, I found that many of these quartz chips were brought to light at every succeeding freshet of the season, being washed out of the sand by descending drainage. Their immense and continually increasing numbers seemed to warrant the belief that they had resulted from systematic operations of some sort, once conducted, for unknown purposes, upon this particular spot. A portion of the studied specimens subsequently yielded evidence of having received shape from human hands, and therefore it was assumed provisionally that the site of exposure represented a prehistoric workshop.

"Prolonged investigation ensued; and investigation established the hitherto unsuspected fact that no quartz chips nor fragments were enclosed in the upper part of the gravel and sand terrace at the notch, nor within a considerable distance at either hand, though they were sought with careful scrutiny. . . . Ultimately it was ascertained that the notch quartzes had dropped to the level at which they were seen from a thin layer of them once lying from ten inches to two feet above it, and subsequently broken up through the wearing away of the sand underneath by drainage. This layer or stratum was still intact on the north and south and partially so on the east, in which direction it had, however, at certain points, suffered some displacement by wagoning. It extended in a nearly horizontal plane into the terrace, in the sloping edge of which the notch, opening into its west bank and truncated at its edge, is cut. . . . The quartz-bearing layer averaged a few inches only in thickness, varying a little as the included pieces happened to be of smaller or larger size. The contents were commonly closely compacted, so much so that one might sometimes extract hundreds of fragments, many of them very small ones, of course, from an area of considerably less than a square yard.

"The quartz bed, so far as examined, rested upon a few inches of sandy soil, which passed downward into a coarse waterworn gravel, immediately overlying till. Above the quartz chips, stratified gravel and sand extended up to the surface of the terrace. The pebbles of the gravel lying directly on the quartz-bearing stratum were small and well rounded, and were noticeably less angular than those of the gravel below. The stratum of quartz chips lay at a level some twelve or fifteen feet lower than the plane of the terrace-top.

"These observations show that the quartz chips were spread originally upon an ancient surface that has been since covered deeply by the modified drift which forms the terrace. It will be remembered that the quartz chips and implements discovered by Prof. Winchell in this vicinity are contained in the upper stratum of the terrace-plain; but the notch quartzes do not occur at the terrace-top, and cannot have been derived from it, but are confined strictly to a single stratum of the lower gravels closely overlying the till. Hence the two sets of objects cannot be synchronous, though they may have been produced by the same race at different stages of its existence. The notch quartzes must, of course, be older than those described by Prof. Winchell, by at least the lapse of time required for the deposition of the twelve or fifteen feet of modified drift forming the upper part of the terrace-plain, above the quartz-bearing stratum."

This description by Miss Babbitt shows that these implements and fragments of chipped quartz occurred in a well defined thin layer in the modified drift forming the glacial flood-plain of the Mississippi river, as shown in the section which I have drawn (see the following figure). I have examined the terraces and plains of this valley drift from St. Paul and Minneapolis to Brainerd, some twenty-five miles north of Little Falls, and find them similar in material and origin with the modified drift terraces in the valleys of the Merrimac, Connecticut and other rivers in New England. These water-courses extending southward from the region that was covered by the ice-sheet became the avenues of drainage from it during its retreat. A part of the drift which had been contained in the lower portion of the ice was then washed away by the streams formed on the ice in its rapid melting and was deposited as modified drift, forming layers of gravel, sand and fine silt, in the valleys along which the floods supplied by this melting descended toward the


W.
Modified Drift
Till
Mississippi River
Bottomland (Alluvium)
Stratum containing quartz chippings
Terrace of Modified Drift, 25 ft. above river
Till
E.

SECTION ACROSS THE MISSISSIPPI VALLEY AT LITTLE FALLS, MINNESOTA, showing the stratum in which chipped quartz fragments were found by Miss Franc E Babbitt, as described in Proc. of A.A.A.S., Vol. xxxii, pp 385–390.

ocean. Along the Mississippi the flood-plain of modified drift at Brainerd has a height of about 60 feet above the river; at Little Falls, as before noted, its height is 25 to 30 feet; at Saint Cloud, 60 feet; at Clearwater and Monticello, 70 to 80 feet; at Dayton, 45 feet; and at Minneapolis, 25 to 30 feet above the river at the head of Saint Anthony's Falls.

The modified drift at Little Falls lies on the till or direct deposit of the ice-sheet, and forms a surface over which the ice never readvanced. It lies far within the area that was ice-covered in the second and latest principal epoch of glaciation, and by reviewing the steps in the recession of the ice of that epoch we shall be able to ascertain approximately what were the outlines of its receding margin when the gravel and sand plain of Little Falls was deposited, enclosing these evidences of man's presence. The ice-sheet, supplying both this modified drift and the floods by which it was brought, still covered much of the upper part of the Mississippi basin, which only reaches about a hundred miles north of Little Falls; and the courses of massive morainic belts show the continuation of the glacial boundary northwestward across Dakota and with less clearness eastward across the Laurentian lakes.

When the latest North American ice-sheet attained its greatest area, its southern portion from lake Erie to Dakota consisted of vast lobes, one of which reached from central and western Minnesota south to central Iowa. This lobe in its maximum extent ended near Des Moines, and its margin was marked by the Altamont moraine, the first and outermost in the series of eleven distinct marginal moraines of this epoch which are recognizable in Minnesota. When the second or Gary moraine was formed, it terminated on the south at Mineral ridge in Boone county, Iowa. At the time of the third or Antelope moraine, it had farther retreated to Forest City and Pilot mound in Hancock county, Iowa. The fourth or Kiester moraine was formed when the southern extremity of the ice-lobe had retreated across the south line of Minnesota and halted a few miles from it in Freeborn and Faribault counties. The fifth or Elysian moraine, crossing southern Le Sueur county, Minnesota, marks the next halting-place of the ice. At the time of formation of the fifth moraine, the south end of the ice-lobe had been melted back a hundred and eighty miles from its farthest extent, and its southwest side, which at first rested on the crest of the Coteau des Prairies, had retired thirty to fifty miles to the east side of Big Stone lake and the east part of Yellow Medicine county. During its next stage of retreat this ice-lobe was melted away from the whole of Le Sueur county, and its southeast extremity was withdrawn to Waconia, in Carver county, where it again halted, forming its sixth or Waconia moraine. The seventh or Dovre moraine marks a pause in its recession when its southeast end rested on Kandiyohi county. Probably nearly all of the southern half of Minnesota was at this time divested of its ice-mantle, while nearly all of the northern half was still ice-covered, the glacial boundary across the state passing in an approximately east to west course not far from Little Falls.

By its next recessions the ice-border was withdrawn to the eighth or Fergus Falls moraine, and the ninth or Leaf Hills moraine. These are merged together in the prominent accumulations of the Leaf Hills, which reach in a semicircle from Fergus Falls to the southeast, east and northeast, a distance of fifty miles, marking the southern limits of this ice-lobe when it terminated nearly due west of Little Falls and half-way between the south and north borders of Minnesota. Conspicuous morainic hills a few miles east of Little Falls, and others in the north part of Morrison county and along its west side, seem to be correlated with the Fergus Falls moraine. Much of the modified drift of the Mississippi valley at Little Falls was probably deposited when the ice-sheet terminated at these hills five to fifteen miles distant on the east, north and west. Eastward from Morrison county, this moraine continues northeast to the north side of Mille Lacs, thence probably through the south edge of Aitkin county and the north part of Pine county, and onward northeasterly to the west end of lake Superior. The Leaf Hills moraine extends from the northeast part of the Leaf Hills, near the Leaf lakes, east across northern Todd county and northwestern Morrison county, and then north-northeast by Gull, Pelican, White Fish and Crooked lakes. Next it probably takes an eastward course, crossing the Mississippi several miles north of Sandy lake and the Saint Louis river near the mouth of the Cloquet, and thence an east-northeast course, passing not far south of the Cloquet river and reaching the north shore of lake Superior about half-way between Duluth and Pigeon point. The upper portion of the modified drift at Little Falls, probably including the stratum of chipped fragments of quartz, is referable to the time of the recession of the ice-sheet north from the Fergus Falls moraine to the Leaf Hills moraine. At the west end of the Leaf Hills and thence through a distance of fifty miles northward, this stage of recession carried the ice-border back only five to ten miles; and in the main Leaf Hills, as before noted, the two moraines are united. Across the Mississippi basin the glacial recession between them uncovered an area mainly twenty to forty miles wide. The portion of the ice-sheet nearest to Little Falls at the time of the Leaf Hills moraine was in the vicinity of Fish Trap lake and lake Alexander, in northwestern Morrison county, only twenty miles distant. There, as in the Leaf Hills, this moraine and that of Fergus Falls come together. Ascending the Mississippi, a distance of eighty miles intervened between Little Falls and the ice-border at the time of the Leaf Hills moraine, which extends approximately parallel with the river and ten to twenty miles from it on its northwest side in passing north-northeastward from Morrison county.

During the formation of the tenth or Itasca moraine, and of the eleventh or Mesabi moraine, crossing the lake region at the head of the Mississippi, the gravel and sand of the modified drift were probably wholly deposited north of Little Falls. Later moraines, formed at times of halt or re-advance, interrupting the recession of the ice-sheet between northern Minnesota and Hudson bay, have not been determined, but I believe that they exist and await discovery when the glacial drift of that wooded and very scantily inhabited region shall be fully explored. The many beaches of lake Agassiz, all showing an ascent northward when compared with the level of the present time, but with this ascent gradually decreased during the successive stages of the lake, probably find their explanation in the manner of retreat of the ice in Canada, interrupted there, as farther south, by pauses and the formation of moraines.

Contemporaneously with the deposition of the glacial flood-plain at Little Falls and the accumulation of the Leaf Hills, the ice-front forming the north shore of lake Agassiz crossed the Red river valley between Fargo and Grand Forks, and extended northwesterly across northern Dakota, as shown by its moraines remarkably developed along the south side of Devil's lake and onward to Turtle mountain. Toward the east, the ice-sheet at this time had receded from the southwest part of lake Superior, which was held about 500 feet higher than now and overflowed to the Saint Croix and Mississippi rivers by the way of the Bois Brulé river and Upper Saint Croix lake. It seems nearly certain also that the ice-border continued across Green bay and the north part of lake Michigan; and farther east I think that it probably crossed southwestern Ontario and the central or northern portions of New York, Vermont, New Hampshire and Maine. The Laurentian lakes were dammed by the retreating glacial barrier and overflowed at the lowest points on their southern watershed. The time when the Little Falls stone implements and fragments from their manufacture were covered by the modified drift seems therefore somewhat later than that of the implements found in southern Ohio and in New Jersey; for, if this was the course of the ice-boundary east from the Leaf Hills of Minnesota, it had already receded beyond the region where the glacial floods could be discharged by the Little Miami and Delaware rivers.

If the question be asked, how many thousand years ago was this, a reply is furnished by the computations of Prof. N. H. Winchell, that approximately 8,000 years have elapsed during the erosion of the postglacial gorge of the Mississippi from Fort Snelling to the falls of Saint Anthony; of Dr. Andrews, that the erosion of the shores of lake Michigan, and the resulting accumulation of dune sand drifted to the southern end of that lake, cannot have occupied more than 7,500 years; of Professor Wright, that streams tributary to lake Erie have taken a similar length of time to cut their valleys and the gorges below their water-falls; and of Mr. Gilbert, that the gorge below Niagara Falls has required only 7,000 years or less. These measures of time carry us back to the date of the Little Falls quartz-workers, when the ice-sheet of the last glacial epoch was melting away from the basins of the Upper Mississippi and of the Laurentian lakes.

Plants and animals doubtless followed close upon the retiring ice-border, and men living in the region southward would make journeys of exploration to that limit, but probably they would not take up their abode for all the year so near to the ice as Little Falls at the time of the Fergus Falls and Leaf Hills moraines. It may be that the chief cause leading men to occupy this locality, so soon after it was uncovered from the ice, was their discovery of the quartz veins in the slate there and on the Little Elk river, affording suitable material for making sharp-edged stone implements of the best quality. Quartz veins are absent or very rare and unsuited for this use in all the rock-outcrops of the south half of Minnesota that had become uncovered from the ice, as well as of the whole Mississippi basin southward, and this was the first spot accessible whence quartz for implement-making could be obtained. While the deposition of the valley-drift at Little Falls was still going forward, men resorted there, and left, as the remnants of their manufacture of stone implements, multitudes of quartz fragments. By the continued deposition of the modified drift, lifting the river upon the surface of its glacial flood-plain, these quartz chips were deeply buried in that formation. The date of this valley-drift must be that of the retreat of the ice of the last glacial epoch, from whose melting were supplied both this sediment and the floods by which it was brought. The glacial flood-plain, beneath whose surface the quartz fragments occur, was deposited in the same manner as additions are now made to the surface of the bottom-land; and the flooded condition of the river, by which this was done, was doubtless maintained through all the warm portion of the year, while the ice-sheet was being melted away upon the region of its head waters. But in spring, autumn and winter, or, in exceptional years, through much of the summer, it seems probable that the river was confined to a channel, being of insufficient volume to cover its flood-plain. At such a time this plain was the site of human habitations and industry. After the complete disappearance of the ice from the basin of the Upper Mississippi, the supply of both water and sediment was so diminished that the river, from that time till now, has been occupied more in erosion than in deposition, and has cut its channel far below the level at which it then flowed, excavating and carrying to the Gulf of Mexico a great part of its glacial flood-plain, the remnants of which are seen as high terraces or plains upon each side of the river.

A general discussion followed, and Professor Haynes showed from his collection, some slightly weathered implements of palæolithic forms which he did not consider to be palæolithic implements.

Professor Morse alluded to the care with which these questions are now studied and the significance of the results obtained.

The President concluded the discussion, stating that all these discoveries of recent years show that man had occupied a portion of North America, from the Mississippi river to the Atlantic ocean, at a time when the northern part of the United States was covered with ice, and that at this early period he must have been contemporaneous with the mastodon and mammoth, south of the great ice barrier of the north, the southern border of which had been so well traced in the several papers read this evening.

The mystery of the bed of quartz chips and rude implements, under the drift at Little Falls, Minnesota, had, he thought, been most satisfactorily explained by the facts brought forward by Mr. Upham, relating to the occurrence of surface quartz-veins near and north of Little Falls, the first available locality for that rock after the recession of the ice. A similar condition exists at Trenton, where the argillite implements are found in the gravel, while the rock from which they were probably made is found in place a short distance to the northward. The only two implements yet known from the Ohio gravels were made of pebbles.

In this connection, the rude chipped implements described by Col. C. C. Jones from the river drift of the Nacoochee valley, must not be overlooked, and it is reasonable to expect the discovery of the implements of man in any of the deposits of the river-drift in the southern states.

When we compare the facts now known from the eastern side of the continent, with those of the western side, they seem to force upon us to accept a far longer occupation by man of the western coast than of the eastern; for not only on the western side of the continent have his remains been found in geological beds unquestionably earlier than the gravels of the Mississippi, Ohio and Delaware valleys, but he had at that early time reached a degree of development equal to that of the inhabitants of California at the time of European contact, so far as the character of the stone mortars, chipped and polished stone implements, and shell beads, found in the auriferous gravels, can tell the story. On the Pacific coast, where the conditions of life were more favorable, he had passed beyond the palæolithic stage before his works were buried in the gravels under the beds of lava; while at a later period on the Atlantic coast he was still in the palæolithic stage. Either this must be accepted, or else the geological changes on the Pacific coast have been entirely misunderstood; for we can no longer question the many instances of the discovery of the works of man, and also of his bones, in the Californian gravels. The same story is told by the beautifully chipped implement of obsidian found by Mr. McGee in the quaternary deposits of Lake Lahontan in Nevada.

It is also of importance to recall that it is at the north, across the country from the Pacific to the Atlantic, and down both the Pacific and Atlantic coasts, that the skulls found in the old burial places show that the followers of this early man were a dolichocephalic people; while a brachycephalic people were distributed over the area thus enclosed, with greater or less admixture along the borders, where the two forms of skulls are found together in burial places, here and there, and an intermediate or a mixed cranial form is common.

The extreme northern or Eskimo type of skull is dolichocephalic, and many of the old crania of the borderland between the Eskimo and the long-headed race extending across the continent show signs of mixture, particularly among the older skulls on both the Atlantic and Pacific portions of this region. The probabilities are thus in favor of palæolithic man having been dolichocephalic, as well as the race with which he came in contact. Was he pushed to the north? Do we find his descendants in the Eskimo?

The fact made known by Dr. Abbott, that the slender points chipped from argillite are later than the ruder argillite implements found in the gravel, and far earlier than the chipped implements left by the Delaware tribes known to history, are indicative of an advance of palæolithic man before he was driven from the Delaware valley. The important discoveries, made by Mr. H. T. Cresson, of the remains of pile structures along the shores of the Delaware and the character of the argillite implements found in the mud about the piles, point in the same direction.

However these suppositions may turn out in the future, as new facts are discovered, it is certainly most encouraging that the discoveries by Dr. Abbott, Miss Babbitt and Dr. Metz, have been so thoroughly correlated by the careful geological observations of such men as Professor Wright and Mr. Upham who have addressed us to-night, and by Mr. McGee, from whose paper abstracts have been read by Dr. Abbott. This shows how carefully the work is being done; and that a steady advance is being made in working out the great problem of the origin and distribution of man in America.